FD 255

crawler dozer

Operation and Maintenance Instruction Manual

Print N°. 604.00.761

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WARNING

STUDY THE OPERATION AND MAINTENANCE INSTRUCTION MANUAL THRUOGH BEFORE STARTING, OPERATING, MAINTAINING, FUELING OR SERVICING THIS MACHINE.

This symbol is your safety alert sign. It MEANS ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED.

Read and heed all safety instructions carrying the signal words WARNING and DANGER.

Machine mounted safety signs have been color coded yellow with black borders and lettering for WARNING and red with white borders and lettering for DANGER points.

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SAFETY RULES

GENERALITIES

Study this Manual before starting, operating, maintaining, fuelling or servicing the machine.

Read and heed all safety rules before any intervention.

Do not allow unauthorised personnel to operate service or maintain this machine.

Avoid seating in the operator's compartment and start working if feeling in poor health conditions.

Do not wear rings, wrist watches, jewellery, loose or hanging apparels, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can catch on moving parts. Wear proper safety equipment as recommended for the job. Examples: hard hat, heavy gloves, ear protection, safety glasses or goggles, reflector vests, respirator. Consult your employer for specific safety equipment requirements.

Keep operator's compartment, stepping points, grab-rails and handles clear of foreign objects, oil, grease, mud or snow accumulation to minimize the danger of slipping or stumbling. Clean mud or grease from shoes before attempting to mount or operate the machine.

Do not jump on or off the machine. Keep two hands and one foot, or two feet and one hand in contact with step grab rails and handles at all times.

Do not use controls or hoses as hand holds when climbing on or off machine. Hoses and controls are movable and do not provide a solid support. Controls also may be inadvertently moved causing accidental machine or equipment movement.

Never attempt to operate the machine or its tools from any position other than seated in the operator's seat.

Keep head, body, limbs, hands and feet inside operator's compartment at all times to reduce exposure to hazards outside the operator's compartment.

Be careful of slippery conditions on stepping points, hand rails, and on the ground. Wear safety boots or shoes that have a high slip resistant sole material.

Do not leave the machine until it is completely stopped.

Check the seat safety belt at least twice a year. If there are signs of wear or fraying or other signs of weakness that could lead to failure, replace it.

STARTING

NEVER START OR OPERATE AN UNSAFE MACHINE. Before operating a machine, always ensure that any unsafe condition has been satisfactorily remedied.

Check brakes, steering and attachment controls before moving. Advise the proper maintenance authority of any malfunctioning part or system.

Be sure all protective guards or panels are in place, and all safety devices provided are in place and in good operating conditions.

Be sure exposed personnel in the area of operation are clear of the machine before moving it or its attachments. WALK COMPLETELY AROUND the machine before mounting. Sound horn. Obey flag man, safety signals and signs.

Before starting machine, check, adjust and lock the operator's seat for maximum comfort and control of the machine.

Fasten your seat belt (when provided).

Obey all flag signals and signs.

Due to the presence on the machine of flammable fluids, never check or fill fuel reservoirs or batteries near open flames, smoking materials or sparks.

REMEMBER THAT STARTING FLUID IS FLAMMABLE. Follow recommendations printed on containers and in the Operation and Maintenance Manual.

DO NOT PUNCTURE OR BURN CONTAINERS.

Containers must be stored in fresh, well ventilated places, out of reach of unauthorised persons. Follow strictly the instructions provided by the Manufacturer.

Never use these preducts near open flames, smoking materials or sparks.

OPERATION

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

Roll Over Protective Structures are required on loaders, dozers, graders, excavators. NEVER OPERATE machines without ROPS.

Make sure the Operator's compartment is free of foreign objects, especially if not firmly secured. Never use the machine to transport objects, unless proper securing points are provided.

Check monitoring instruments at start-up and frequently during operation if the brake pressure gauge sugnals a pressure lower than the minimum operation value, stop immediately the machine.

DO NOT CARRY RIDERS ON MACHINE

Study and familiarize with escape routes alternate to normal exit routes.

Seat belts are required to be provided with Roll Over Protection Structures or cabs. Keep safety belts fastened around you during operation.

For your personal protection, do not climb on or off machine while machine in motion.

Make sure that exposed persons in the area of operation are clear of the machine, before starting the engine and operating the equipment. Obey all indications provided by flags and signals.

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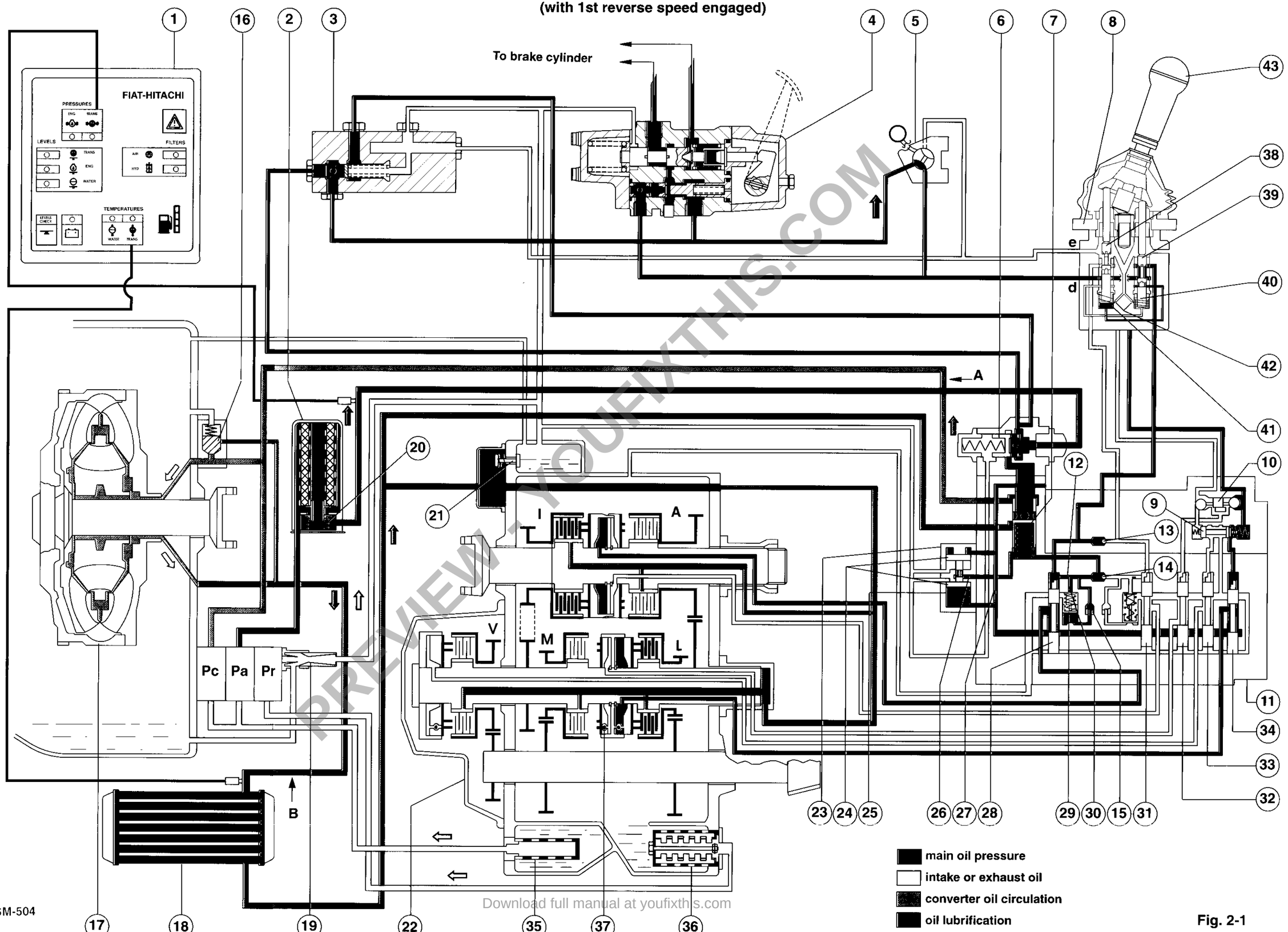
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DEVICES OUT OF IGNITION KEY

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CONVERTER-TRANSMISSION HYDRAULIC SYSTEM DIAGRAM
(with 1st reverse speed engaged)



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Fig. 2-1

1.3 DISASSEMBLY OF THE ENGINE ON BENCH

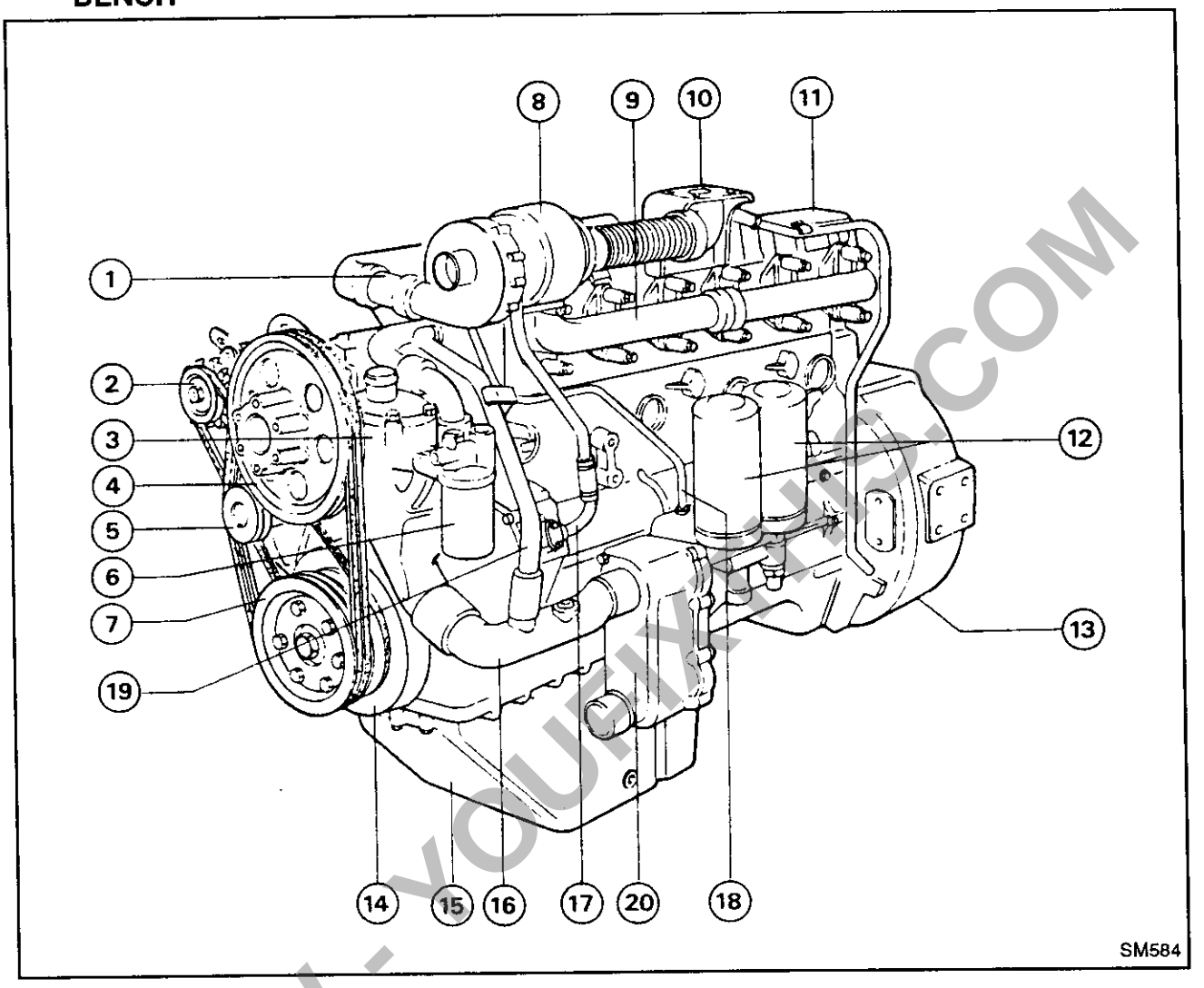


Fig. 1-1

Mount the engine on rotary stand **75301124**; drain the lubrication oil from the engine sump. Remove the oil dipstick pipe. Remove the fan assembly.

Proceed with the disassembly of the engine removing:

- engine oil filters (**12**, fig. 1-1);
- engine coolant filter (**6**);
- turbocharger (**8**) and the relevant piping (**1**) and silencer support (**10**);
- pipes (**16**,**17**,**18**,**19**);
- exhaust manifold (**9**);
- the alternator-fan drive belts;
- fan pulley (**4**) and its support;
- pulleys (**2**,**5**,**7**);
- dumper (**14**);
- the two rocker arm covers (**11**);
- water pump (**3**) complete with thermostats;
- engine oil heat exchanger (**20**).

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1.6 TIGHTENING TORQUE

USE	REFERENCE	TIGHTENING TORQUE Nm
Screws securing cylinder heads ♦ First phase: pre-tightening; Second phase: pre-tightening; Third phase: angle	Fig. 1-133	 100 100 180° ± 5°
Screws securing main journal caps ♦ Pre-tightening Tightening to angle	Fig. 1-59	 117,5 90° ± 5°
Screws securing con-rods caps ♦ Pre-tightening Angle	Fig. 1-92	 45 90° ± 5°
Screws securing engine flywheel ♦ Pre-tightening Angle	Fig. 1-65	 100 60° ± 5°
Screw securing flywheel housing	Fig. 1-63	142,5
Screw securing flywheel to crankshaft ♦ Pre-tightening Tightening to angle	Fig. 1-151	 200 90° ± 5°
Screw securing intake manifold	-	32,5
Screw securing exhaust manifold	-	40
Screw securing rocker arm shaft supports Pre-tightening Tightening to angle	Fig. 1-140	 17 180° ± 5°
Screw securing engine to frame supports: C_1 C_2 C_3 C_4 C_5	Fig. 1-179	 47.5 ÷ 52.5 daNm 17 ÷ 19 daNm 22.5 ÷ 25 daNm 22 ÷ 24.5 daNm 22 ÷ 24.5 daNm
♦ Lubricate with engine oil prior to tightening		

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TROUBLE - SHOOTING

ENGINE		
CASE	TROUBLE	PROBABLE CAUSES
M 1	Starter motor inoperative	- Battery cut-off master switch OPEN or FAULTY - Dead battery - Link fuses burnt - Starter switch faulty - Starter solenoid faulty - Starter motor faulty
M 2	The starter motor crancks, but the engine does not start	- Lack of fuel - Fuel filter clogged - Electric stop faulty - Injectors clogged - Injection pump faulty
M 3	The engine smokes a lot and lacks power	- Injectors faulty - Injection pump out of calibration or faulty
M 4	The engine does not stop, in spite of specific comand	- Electric stop linkage out of line - Electric stop faulty

TRANSMISSION		
CASE	TROUBLE	PROBABLE CAUSES
T 1	Low lube oil pressure The indicator comes ON with engine running	- Transmission oil level low - Converter pump suction filter clogged - Suction piping clogged - Oil inappropriate
T 2	Transmission pressure normal in neutral, but low when transmission engaged. The machine is difficult to start in one direction and the torque is insufficient	- Plunger of direction modulating valve seized - Orifice of modulating valve plunger clogged

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DIMENSIONS	Overall lenght (bare tractor)		mm	4490
	Overall lenght (with semi-U blade)		mm	5855
	Overall lenght (with angledozer blade)		mm	5800
	Overall width (bare tractor)		mm	2940
	Overall width (with semi-U blade)		mm	3650
	Overall width (with angledozer blade)		mm	4460
	Overall height (to tip of exhaust pipe)		mm	3400
	Overall height (with ROPS canopy)		mm	3420
	Track gauge		mm	2070
	Minimum distance from ground		mm	460
	Lenght of track on ground		mm	2973
	Track shoe width (standard)		mm	550
MASS	Shipping weight (including ROPS canopy, blade lift cylinders, lubricants, coolant, 10% fuel)		kg	21845
	Operating weight with semi-U (HSU) blade and ROPS cab.		kg	27000
	Operating weight with angle (HA) blade and ROPS cab.		kg	26400
PERFORMANCE	SPEEDS	Fwd 1st	Km/h	3.7
		Fwd 2nd	Km/h	6.1
		Fwd 3rd	Km/h	10.9
		Rev 1st	Km/h	4.4
		Rev 2nd	Km/h	7.2
		Rev 3rd	Km/h	12.6
	NOISE LEVEL	Inside cab standard (Lpa) ISO 6394	dB	83
		Inside cab standard (Lpa) CEE 86/662	dB	83
		Outside (Lwa) ISO 6394	dB	113
		Outside (Lwa) CEE 86/662	dB	113
	GROUND PRESSURE	(Track shoes width 550 mm)		
		With semi-U (HSU) blade and ROPS cab	bar	0.8085
		With angle (HA) blade and ROPS cab	bar	0.791
		With semi-U (HSU) blade, ROPS cab and ripper	bar	0.910
	GRADEABILITY	(1st speed)	degree	45

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1.5.1 CALIBRATION DATA OF INJECTION PUMP

Injection pump: PES6P120A720RS3356 (BOSCH)
Governor: RQV450 - 1050PA1245
Fuel pump: FP/KG24P202
Pressure tubing (ENGINE): ø 6 x ø 1.75 x 820 mm
Setting of injector (ENGINE): 260 + 8 bar
Low engine idle speed: 850 ± 50 rpm
Static connection 23 ± 30' degrees before T.D.C. with plunger no. 1 of injection pump in delivery start position and piston no. 1 of the engine in compression stroke.

Test bench with static and dynamic characteristics in accordance with ISO 4008/1 and 4008/2 standards.
Tubing ø 8 x ø 3 x 600 mm 1 680 750 089 (BOSCH)
Injectors 1 688 901 105 (BOSCH) (calibrated orifice diam. 0.8 mm)
Setting of injectors 207 + 3 bar
Test fluid in accordance with ISO 4113 standard, temperature: 38 + 42°C
Feeding pressure: 1.5 bar
Glass emptying time: 30 sec.s
Relief valve set at 1.0 + 1.5 bar

INTERNAL PHASING OF PUMP (Spill point test - Stop block disconnected)	
Plunger pre-lift (in correspondence with port closing)	3.55 ± 0.05 mm (from B.D.C.)
Firing order .	1 - 5 - 3 - 6 - 2 - 4
Rotation direction	clockwise

BASIC TEST OF PUMP (Stop block disconnected)					
Type of operation	Pump speed rpm	Rack travel mm	cucm/100 delivery	Max. variation between cyl.(cucm)	Pressure on LDA (bar)
Setting	1050	9.35 ± 0.05	15.8 ± 0.1	0.5	-
Test	450	4.8 ± 0.1	2.4 ± 0.3	0.8	-

BASIC TEST OF GOVERNOR PERFORMANCE (Stop block disconnected)					
HIGH SPEEDS			LOW SPEEDS		
Position of lever from horiz. center line	rpm pump	Travel of rack (mm)	Lever position	rpm pump	Travel of rack (mm)
118° ± 4° with respect to horizontal position	1135 ± 5	8.3	71° ± 4 with respect to horizontal position	450	4.8 ± 0,1
	1225 ± 15	4.0		100	19.5 MIN.
	1400	0 + 1			

FINAL CALIBRATION OF PUMP - WITH GOVERNOR - With stop block reinstalled - horizontal				
Type of operation	Pump speed rpm	cucm/100 delivery	Max. variation between cyl. (cucm)	Pressure on LDA (bar)
Setting of governor	1135		-	-
Minimum	450	24 ± 3	8	-
Start	100	130 ± 15	-	-

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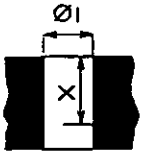
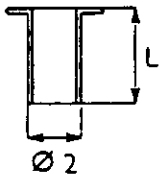
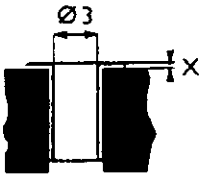
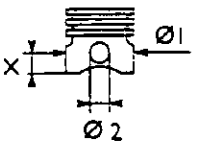
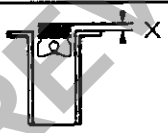
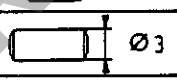
SETTING VALUES AND TESTS

			STANDARD VALUE	PERMIS. VALUE
ENGINE SPEED	Nominal idling speed (50 hour break-in)		2100 rpm	–
	High idling speed (50 hour break-in)		2300 rpm	± 50
	Low idling speed (50 hour break-in)		850 rpm	± 50
	Converter stall (50 hour break-in)		2000 ÷ 2140 rpm	-100
	Implement stall (50 hour break-in)		2160 ÷ 2280 rpm	-100
	Stall (50 hour break-in)		1610 ÷ 1800 rpm	-100
ENGINE LUBRICATION SYSTEM	Oil pressure	At governed speed MAX	6 bar	± 1.5
		MIN	4.6 bar	± 1.5
	Oil temperature	all speed	90 - 120°C	130
	Blow - by total	900 rpm Oil temperature 70°	29 l/min	–
INTAKE AND EXHAUST SYSTEM	Intake resistance	At rated speed and full load	450 mm H_2O	625
	Exhaust pressure	At rated speed and full load	947 mm Hg	–
	Exaust temperature	110 rpm (intake air temperature 20°C)	630°C	680
	Grade of smoke	Smoke (Bosh scale rated speed rpm)	0.5	3.5
		(Bosh scale max torque rpm)	1	5
		Emissions (ECE 49 without fan and turbocharger)		
		NOx	14.68 g/KWh	14.68
		Co	1.96 g/KWh	1.96
		Hc	0.53 g/KWh	0.53
		Powder emission	0.22 g/KWh	0.22
ENGINE BODY	Compression pressure	Oil temperature 40 - 50°C w/cranking motor	29.5 bar	27.5
	Effective mean pressure	Oil temperature 40 - 50°C	13.6 bar	–
	Piston average velocity		9.8 m/s	–
	Valve clearance	Intake valve (engine cold)	0.25 mm	0.25 mm
		Exhaust valve (engine cold)	0.50 mm	0.50 mm
COOLING SYSTEM	Fan speed	At rated engine speed	1400 g/min	-30
	Radiator pressure valve	Opening pressure	0.7 bar	± 0.15
	Fan belt tension	(Dynamometer value)	65 - 70 daN	62

NOTE: The values in the table are referred to engine on test bench.

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1.5.2 FITTING DATA

CYLINDER BLOCK AND CRANK MECHANISM			mm
	Cylinder sleeve housing:		
	Ø 1	top	137.010 ÷ 137.035
		bottom	134.000 ÷ 134.025
	Cylinder sleeve:		
	outer diameter		
	Ø 2	top	136.975 ÷ 137.000
		bottom	133.972 ÷ 133.990
	Lenght	L	-
	Cylinder sleeve engine block housing	top	0.010 ÷ 0.060
		bottom	0.010 ÷ 0.053
	Outer diameter	Ø 2	-
	Cylinder sleeve:		
	Inner diameter	Ø 3	119.990 ÷ 120.015
	Sleeve protrusion	X	0.04 ÷ 0.07
	Piston:		
	Measured at	X	20
	Outer diameter	Ø 1	119.863 ÷ 119.877
	Pin bore	Ø 2	48.008 ÷ 48.012
	Piston - cylinder sleeve		0.113 ÷ 0.152
	Piston diameter	Ø 1	-
	Piston protrusion	X	max 0.75
	Piston pin	Ø 3	47.985 ÷ 47.993
	Piston pin - pin clearance		0.015 ÷ 0.027
	Piston pin grooves	X 1*	3.20 ÷ 3.23
		X 2	3.06 ÷ 3.08
		X 3	5.03 ÷ 5.05

* Measured on 117 mm Ø diameter.

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LIST OF PROGRAMMED MAINTENANCE OPERATIONS

Every 10 Hours	1. TRACK FRAME INBOARD SUPPORTS - Lubricate 2. CAB VENTILATION AIR FILTER - Check
Every 50 Hours	3. CAB VENTILATION AIR FILTER - Clean
Every 100 Hours	4. BEVEL GEAR - STEER. CLUTCHES AND BRAKES - Check oil level 5. SIDE FINAL DRIVES - Check oil level 6. HYDRAULIC SYSTEM - Check oil level 7. DOZER BLADE CYLINDER LINKAGE - Lubricate 8. RIPPER LINKAGE - Lubricate
Every 250 Hours	9. FUEL LIFT PUMP FILTER - Clean 10. FIRST FUEL FILTER - Change 11. ENGINE OIL - Change 12. ALTERNATOR/FAN DRIVE BELTS - Check 13. STEERING CLUTCHES/BRAKES - Change oil filter on return line 14. FUEL SEDIMENTATION FILTER - Draining condensation
Every 500 Hours	15. ENGINE OIL FILTERS - Change 16. SECOND FUEL FILTER - Change 17. CONVERTER/TRANSMISSION - Change oil 18. CONVERTER/TRANSMISSION - Change delivery oil filter 19. HYDRAULIC SYSTEM - Change return oil filter 20. COOLING SYSTEM INHIBITOR FILTER - Change 21. CAB VENTILATION AIR FILTER - Change
Every 1000 Hours	22. ENGINE - Check fuel injector calibration 23. ENGINE - Check valve clearance 24. CONVERTER/TRANSMISSION - Clean suction filters 25. BEVEL GEAR - STEER. CLUTCHES AND BRAKES - Change oil 26. BEVEL GEAR - STEERING CLUTCHES and BRAKES - Change oil 27. SIDE FINAL DRIVES - Change oil 28. DRIVE SHAFT - Pack grease fittings 29. BATTERIES - Check electrolyte level
Every 2000 Hours	30. HYDRAULIC SYSTEM - Change oil 31. RADIATOR - Change coolant 32. AIR CLEANER - Change elements
Every 3000 Hours	33. AIR CONDITIONER FILTER - Change
When required (indicator signals)	34. CONVERTER/TRANSMISSION - Top-up level 35. ENGINE OIL - Top-up level 36. RADIATOR - Top-up coolant level 37. HYDRAULIC SYSTEM - Change return oil filter 38. AIR CLEANER - Clean
Variable periodic services	39. TRACKS - Check tension 40. TRACK IDLERS AND ROLLERS 41. FUEL SYSTEM BLEEDING

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PRELIMINARY INSTRUCTIONS AND RUNNING-IN

PRELIMINARY INSTRUCTIONS

Upon delivery of the machine, the Sales Organization Representative/s provide the Customer with the main instructions relative to the operation and maintenance of the machine.
These instructions are summarized in the list here below:

- decanting of fuel;
- check levels: coolant, fuel and oils;
- drain deposits from fuel reservoir;
- bleed air from fuel system;
- starting and stopping the engine and the machine;
- rules for a safe operation of the machin;
- running-in;
- operation of the machine and equipment.
- lubrication and lubricants;
- maintenance of air cleaner;
- maintenance of filters: fuel, engine oil and hydraulic fluid;
- maintenance of engine cooling system (the system is filled at the Factory with a mixture of water and glycol type anti-freeze fluid);
- maintenance of hydraulic systems: torque converter-transmission, steering, equipment;
- check the tooling.

Start the engine. Check all instruments and indicators; actuate the controls of the machine to ensure that they operate correctly. Stop the engine and check sleeves, pipings and connections for leakages.

BREAK- IN PERIOD

A minimun break-in period of 60 hours is required. Proceed as follows:

- before driving away after a cold starting, warmup engine at idle speed for a few minutes;
- avoid prolonged full power operation;
- inspect the machine frequently, making sure there are no oil or coolant leaks.

During the initial period of machine operation, in addition to the routine maintenance described in the relevant section, you are advised to carry out the following supplementary servicing operations that later may be omitted or protracted to loger intervals.

Within the first 50 hours:

- change engine oil and associated filter.

Within the first 100 hours:

- change fuel filter;
- change converter/transmission oil and associated filter;
- change filter or return line of hydraulic system to the reservoir.

Within the first 300 hours:

- check fuel system and engine valve clearance.

All the above recommendations apply also to newly overhauled machines.

WARNING

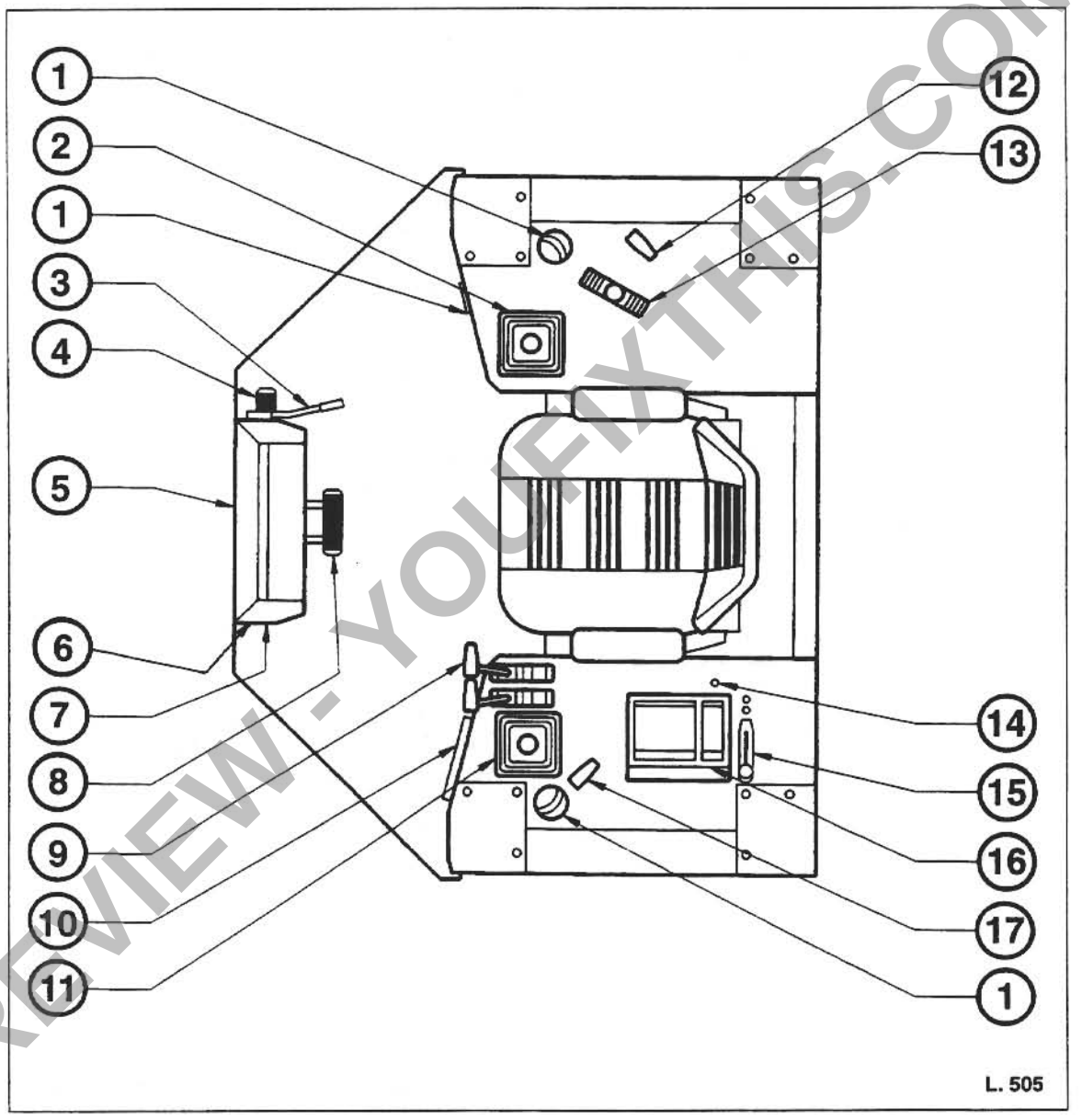
Never lubricate, service, or adjust with engine running except as called for in the Operation and Maintenance Instruction or Service Manuals to keep from being caught in moving parts or by a moving machine.

WARNING

Warn all people who may be servicing or working around machine before starting engine.
Do not run engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.

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CONTROLS AND INSTRUMENTS



Note - The terms left and right used in the text of this Manual, refer to the operator seated in its seat and looking forward.

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FLUID CAPACITIES

ITEM	QUANTITY Liters	FIAT PRODUCT Brand	REFILL (Internation classification)
Cooling system	65	PARAFLU 11	50-50 mixture of water and coolant. Has adequate protection against: oxidation, foaming, corrosion, scaling and freezing down to -35°C (-31°F)
Fuel tank	495	-	Diesel fuel ASTM No. 2-D type TT of good quality and brand
Engine	22	AMBRA SUPER 15W40	Engine oil "CCMC D4" or Service "API CF-4" or "MIL - L - 2104 E level"
Bevel-gear, Steering clutches brakes	82	AMBRA SUPER 15W40	Engine oil "CCMC D4" or Service "API CF-4" or "MIL - L - 2104 E level"
Convertor/transmission	67	TUTELA GI/M	ATF Type A SUFFIX A
Equipment hydraulic system	130	IDRAULICAR AP 31-51	Engine oil DIN 51524/2 or MIL-H-24459 or ISO VG 32 - 68
Side final Drives	82	TUTELA SAE80W90/M-DA	Oil for mechanical drives MIL-L-2105 D
Track idlers and rollers	9	AMBRA SUPER 15W40	Engine oil "CCMC D4" or Service "API CF-4" or "MIL - L - 2104 E level"
Grease fittings	-	TUTELA G9	Lithium-calcium base grease, N.L.G.I. 2 consistency
Cab tipping pump	0,5	TUTELA GI/M	ATF Type A SUFFIX A

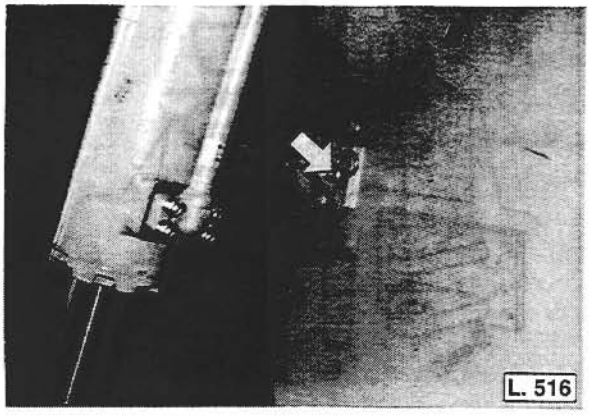
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MOVING THE MACHINE WITH EXTERNAL HELP

MACHINE TRANSPORT

When transporting the machine with blade removed, fasten the cylinders using the pins provided as shown in illustration.



Loading

Before loading the machine make sure that ramps and carrier trailer platform are lined with suitable non-skid material (wood, rubber, etc.) so that they are well fixed (avoid use of loose wood planks, tire covers ect.).
Proceed as follows:

- apply tractor and trailer brakes;
- lower rear trailer stabilizers onto ground;
- align the machine tracks properly with the ramps, for correct climbing;
- use a signaller who can easily see the ramp, loading platform, operator and machine;
- lift tools just enough off of grounds, to not interfere with the loading operation;
- climb up very slowly, with blade close to trailer platform;
- avoid directional change while machine is on ramps;
- position the machine on platform, so as to ensure optimum load distribution: any shifting of machine should be done smoothly, avoiding sudden starts and stops;
- lower the tool, apply emergency brake, follow all rules for stopping and leaving machine.

Transport

Before leaving:

- apply and bolt the wooden chocks to platform at track frame ends and safety bars or chains laterally for safe anchorage and immobilization during transport;
- make sure that cab doors and other movable parts are correctly shut and secured;
- if the machine size exceeds legally established limits, apply the necessary signals as per code requirements.

Unloading

The operations and precautions are the same as those followed when loading, except that in this case the blade must lightly touch the ground to prevent machine from slipping.

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NEVER COAST the machine down grades and slopes with the transmission in neutral or neutralized, or power shift type machines, or clutch disengaged on manually shifted machines.

Do not operate machinery in a condition of extreme fatigue or illness. Be especially careful towards the end of working shift.

Do not operate machine with brakes out of adjustment.

Operate the machine at speeds slow enough to ensure complete control at all times.

Travel slowly over rough terrain, on slopes or near drop-offs, in congested areas or on ice or slippery surfaces.

When backing, always look to where the machine is to be moved. Be alert to the position of exposed personnel. DO NOT OPERATE if exposed personnel enter the immediate work area. STOP THE MACHINE.

Maintain a safe distance from other machines. Provide sufficient clearance for ground and visibility conditions. Yield right-of-way to loaded machines.

Maintain clear vision of areas of travel or work. Keep cab windows clean and repaired.

When machines are operating in tandem, the pusher (rear) must be equipped with the appropriate deflectors to protect the unit in front from the air stream coming from the radiator.

When pulling or towing through a cable or chain, do not start suddenly at full throttle; take-up slack carefully. Inspect carefully for flaws or troubles before using.

Avoid kinking chains or cables. Do not pull through a kinked chain or cable to the high stresses and possibility of failure of the kinked area. Always wear heavy gloves when handling chains or cables.

Be sure chains and cables are anchored and the anchor points are strong enough to handle the expected load. Keep exposed personnel clear of anchor points and cables or chains.

DO NOT PULL UNLESS OPERATOR's COMPARTMENT OF MACHINES INVOLVED ARE PROPERLY GUARDED AGAINST POTENTIAL CABLE OR CHAIN BACKLASH.

Be alert to soft ground conditions close to newly constructed walls. The fill material and weight of the machine may cause the wall collapse under the machine.

In darkness, check area of operation carefully before moving in with machine. Use all lights provided. Do not move into area of restricted visibility.

If engine has a tendency to stall for any reason under load or idle, report this for adjustment to proper maintenance authority immediately. Do not continue to operate machine, until condition has been corrected.

On machines supplied with suction radiator fans, be sure to periodically check engine exhaust parts for leaks, as exhaust fumes are dangerous to the operator.

In case of enclosed cabs, always let open a discharge to the outside, to ensure air circulation.

Operators must know thoroughly the performances of the machine they are operating. When working on slopes or near sudden level drops of the terrain, avoid areas where ground is loose or soft since rolling-over or loss of control of machine could result.

Where noise exposure exceeds 90 dBA for 8 hours, wear approved ear protection.

When counterweights are provided, do not work machine if they have been removed.

Overtaking manoeuvres must be performed only when absolutely necessary and unavoidable. Beware of possible uneven terrains, poor visibility conditions, the presence of other machinery or persons out of sight.

Operate the machine at a speed adequate to the working conditions in the site and slow enough to ensure complete control at all times.

Check monitoring instruments at start-up and frequently during operations. In case of abnormal condition warnings, stop immediately the machine.

Never use the machine as a work platform or scaffolding, nor other inappropriate operations (i.e pushing railway cars, trucks or other machines).

Be alert of people in the operating area of the machine. When operating a machine, know what clearances will be encountered, overhead doors, cables, pipes, bearing load limitations of ground, bridges, floors or ramps.

When roading, find-out what conditions are likely to be encountered, clearances, traffic congestion, type of road surfacing, etc. Beware of fog, smoke or dust elements that obscure visibility.

When crossing gullies or ditches, move at an angle with reduced speed after ensuring ground conditions will permit a safe traverse.

Explore the working area to identify potential risks such as: slopes, overhangs, pits, demolition rubble, fires, ravines, ditches, soft terrain, heavy traffic, crowded parking areas, closed ambients. In such conditions, proceed with extreme care.

Whenever possible, avoid going over obstacles such as rough terrain, rocks, logs highly irregular ground, steps, ditches, railroad tracks. When obstructions must be crossed, do so with extreme care at an angle, if possible. Reduce speed, shift-down. Ease up to the break over point, pass the balance point slowly on the obstruction and ease down on the other side.

In steep down-hill operation, do not allow engine to over-speed. Select proper gear before starting down grade.

Avoid side hill travel, whenever possible. Drive up and down the slope. Should the machine slipping sideways, turn it immediately downhill.

The grade of slope you should attempt will be limited by factors such as condition of the ground, load being handled, type of machine, speed of machine and visibility.

There is no substitute for good judgement when working on slopes.

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